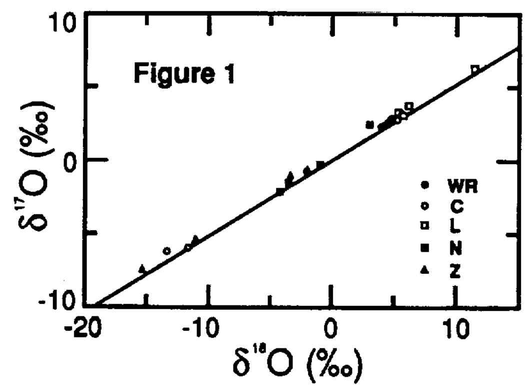
Extraterrestrial water of possible Martian origin in SNC meteorites: Constraints from oxygen isotopes. H. R. Karlsson[1], R. N. Clayton[2], E. K. Gibson[1], T. K. Mayeda[2] and R. A. Socki[1,3]. [1]SN2, NASA/JSC, Houston, TX 77058, [2]EFI, Univ. of Chicago, Chicago, Il. 60637, [3]LESC, Houston, TX 77058, all USA.

Many lines of evidence suggest that the "SNC" group of meteorites (Shergotty-Nakhla-Chassigny) are derived from the planet Mars (1). Because SNC meteorites have water, they may contain information on the origin and fate of water on the planet Mars.

Previous stable isotopic studies of SNC water have concentrated on measuring the D/H ratios using either combustion or pyrolysis techniques. The results are conflicting and none thus far demonstrates conclusively whether the water is extraterrestrial (2, 3, 4).

We present the first measurements of $\delta^{18}O$ and $\delta^{17}O$ of water extracted from SNC's. After overnight room temperature evacuation, powdered samples of Chassigny (2.0 g), Lafayette (3.0 g), Nakhla (2.1 g) and Zagami (2.9 g) were heated under high vacuum and the volatiles evolved were condensed into a cold-trap at liquid nitrogen temperatures. Each sample was heated step-wise to 150°C, 350°C, 600°C and 1000°C, and held at those temperatures for 1hr. Water was then cryogenically separated from other volatiles by raising the cold-trap temperature to that of dry ice. Water was converted to O_2 using BrF_5 and isotopically measured on a double collecting ratio mass spectrometer. Yields (wt%) were: Chas., 0.102; Laf., 0.387; Nak., 0.114; Zag., 0.042.



Clayton and Mayeda (5) have shown that SNC whole rocks lie on a mass fractionation line parallel to the terrestrial line on a three isotope plot, with an average $\Delta^{17}O$ excess ($\Delta^{17}O = \delta^{17}O - 0.52\delta^{18}O$) of +0.3‰ relative to Earth. Our ability to resolve samples from the terrestrial line is at the ± 0.1‰ level (2σ). The water analyses are displayed in Figs. 1-3, where each meteorite is designated by its initial letter. Fig. 1 shows the isotopic composition of the SNC waters relative to the SNC whole rocks (WR) and the terrestrial line. It is clear that the waters as a whole cover a much wider range than the bulk rocks, and that there is a wide variation within waters from individual meteorites. Fig. 2 shows the ^{17}O excess of the SNC water as a function of pyrolysis temperature. Waters entirely of origin on the SNC parent body should have $\Delta^{17}O$ the same as the rocks (dotted line); water of partial terrestrial origin should have $\Delta^{17}O$ between zero and the whole-rock value. In every case the $\Delta^{17}O$ increases with increasing temperature, and is equal to or greater than the whole-rock value for all extractions at ≥ 600°C, implying only a minor terrestrial component in these fractions.

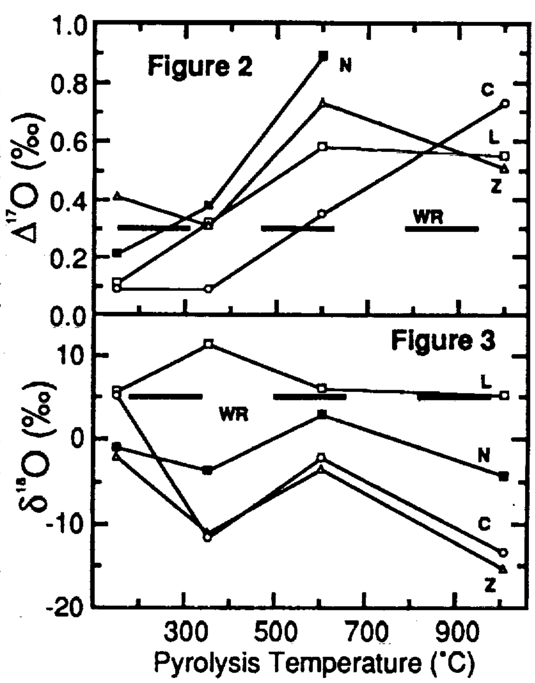


Fig. 3 displays the $\delta^{18}O$ values of the waters as a function of pyrolysis temperature for the four SNC meteorites. Except in the case of Lafayette (find), which probably has a major terrestrial component, similar downward trends are observed. These variations have some interesting implications. One might expect that the highest temperature water would have values close to that of bulk rock (~+5‰) which is not the case for Chassigny, Zagami, and Nakhla (falls). A possible explanation is that the low $\delta^{18}O$ water in Chassigny and Zagami represents samples of trapped Martian atmosphere.

References: (1) Laul J.C. (1986) GCA **50**, 875. (2) Fallick A.E. et al. (1983) LPSC XIV, 183. (3) Kerridge, J.F. (1988) LPSC XIX, 599. (4) Watson et al. (1991) LPSC XXII, 1473. (5) Clayton, R. N. and Mayeda T. K. (1983) EPSL **62**, 1.